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## SPRINGS THAT MYSTERIOUSLY EBB AND FLOW

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*Intermittent springs.*—Here and there occurs a spring that flows a while and stops a while, flows a while and stops a while, day in and day out, year in and year out, to the mental confusion of those who not knowing their cause invent explanations of them as fanciful as a medieval gnome or hobgoblin. There are two kinds of these intermittent springs, namely, the cold-water kind which every physicist understands, and the hot-water kind that not even the chemist fully understands in every particular. The flow of the cold intermittent spring is just the emptying of an underground, air connected (essential for rapid outflow), water cavity by a natural syphon tube. Obviously when the reservoir is emptied to the level of the syphon intake the flow ceases—the spring goes dry and stays dry until the reservoir fills again to the level of the highest bend in the tube whereupon the flow and the stop occur again as before, over and over without end.

The hot-water type, confined to volcanic regions, commonly is called a geyser, even when it just mildly overflows. Its intermittent spurts appear to be the repeated blowing out by steam of an underground reservoir that as often fills up again. Where all this water comes from and how it gets into the steam chamber are not known to the complete satisfaction of everyone. It is easy enough to make a laboratory geyser that works perfectly, but that does not prove that Nature made hers on the same plan—she is very resourceful.

*Dry weather springs.*—Especially in limestone regions, an occasional spring that has become nearly, or even quite, dry starts flowing again or flowing more strongly on the approach of a general rain, hours before a drop of water has fallen within many miles of its place. Sometimes, though relatively rarely, very little rain, or even no rain, falls in the region of the spring for days, or perhaps weeks, after the flow begins; in which case the spring promptly dries up again. Marked fluctuations of this kind are distinctly drought phenomena; they do not occur when rains are frequent enough to maintain a goodly supply of ground-water. Their explanation is simple: The channel to such a spring leads to a cavity which during a prolonged dry spell, when the seepage into it is becoming less and less, gradually empties, slowly filling the while with infiltrated air, until the water pressure at the reservoir outlet, below the surface, is no longer sufficient to force an outflow. If, now, the pressure of

the open air should be lowered while that of the rather closely entrapped air in the half-emptied underground reservoir is unchanged, water would be forced out from the place of the greater to that of the lesser pressure, that is, from the half-filled cavity to the open spring. Now a marked decrease of atmospheric pressure is just what happens at the approach of a general rain, often beginning hours ahead of the precipitation; and, as early, causing certain springs to run again in the midst of a drought, or to run more freely if not yet dry—a mysterious flow, prophetic of rain.

*Night springs.*—Often in the summer time, and especially in dry weather, a weak spring in a deciduous forest runs well at night but feebly, or even not at all, between nine o'clock in the morning and sundown. This is because the ground-water at such localities, as indeed in practically all localities, has two outlets, or two ways of escape, one by seepage and vein-like drainage to springs; the other through evaporation from the myriads of leaves overhead. When evaporation is least, as it is at night, loss by seepage is at its maximum and the spring-flow greatest. When, on the other hand, evaporation is most active, that is, during the warmer daylight hours, tree leakage is largest and spring-flow least, even to complete cessation by mid-afternoon, or earlier. Such is the course and the explanation of the well known, but to few familiar, night spring. In the course of a severe drought such a spring first becomes feeble by day, then flows only at night, and finally neither by day nor at night.

*First-frost springs.*—From the explanation above of "night springs" it is clear that anything that suddenly would shut off tree evaporation would, during a period of dry weather, as promptly strengthen, or even start afresh, many a small forest spring. Clearly, too, the thing that does just that is the first killing frost of autumn. That is why at times and places springs start up anew, and branches flow again, or stronger at least, immediately after the first heavy frost in the fall of the year, and that too without any precipitation to supply the goodly quantity of water where but a day before there had been little or none.

Such (all the above) are at least some of our mysterious springs—mysterious when we do not understand why they behave so differently from most springs, but all the more interesting when we do.